Information from Hunts and Surveys of Walrus *(Odobenus rosmarus)* in Northern Foxe Basin, Northwest Territories, 1982-1984

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ERRATA

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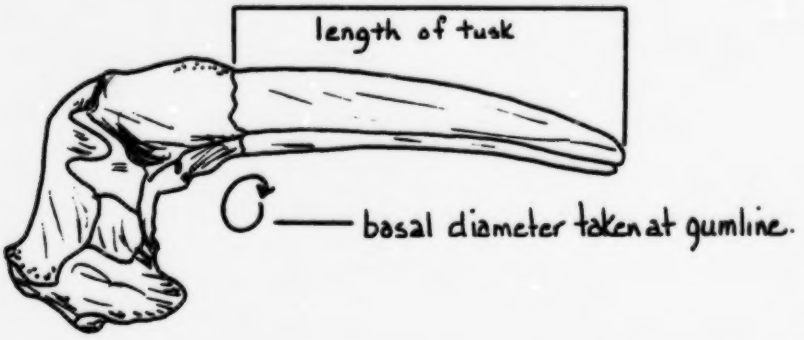
p. iii and p. 11. Table 4 - Northern should read northern.

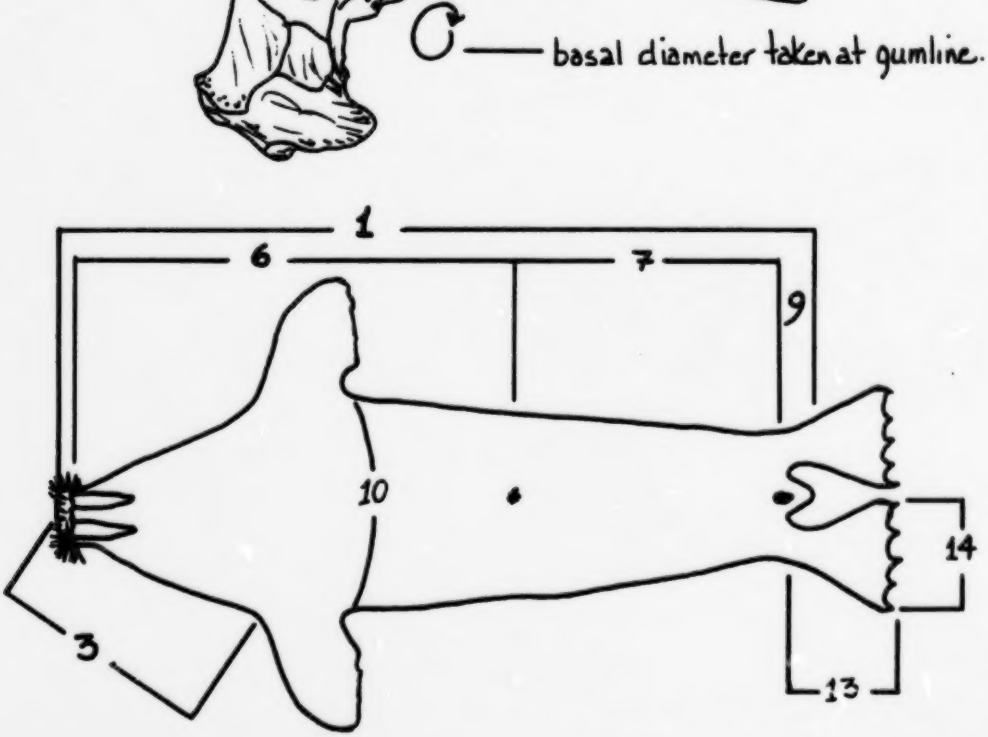
p. 5, col. 1, l. 2 - 17 should read 16, 16 should read 15.

p. 15, caption should read - "Fig. 4. Map of Igloolik Island showing median location of the floe edge in July."

p. 21 - on the reverse side of this page is the second page of Appendix 1. It should have been p. 22. Please insert in your copy of the report.

(1) TOTAL LENGTH _____ CM
(2) TAIL LENGTH _____ CM
(11) FORE FLIPPER LENGTH _____ CM
(13) HIND FLIPPER LENGTH _____ CM
(12) FORE FLIPPER EXPANDED WIDTH _____ CM
(14) HIND FLIPPER EXPANDED WIDTH _____ CM
(10) CIRCUMFERENCE BEHIND FORE FLIPPER _____ CM
(1) TIP OF NOSE TO INSERTION OF FORE FLIPPER _____ CM
(8) CENTRE OF NAVEL TO TIP OF TAIL _____ CM
(9) CENTRE OF ANUS TO TIP OF TAIL _____ CM
(7) CENTRE OF ANUS TO CENTRE OF NAVEL _____ CM
(6) CENTRE OF NAVEL TO TOP OF LOWER JAW _____ CM
(15) DISTANCE BETWEEN MAMMAE (MEDIAL)(ANTERIOR) _____ CM
(16) DISTANCE BETWEEN MAMMAE (LONGIT.)(ANTERIOR & POSTERIOR) _____ CM
(17) FROM LINE BETWEEN ANTERIOR MAMMAE TO CENTRE OF NAVEL _____ CM
(5) CENTRE OF EYE TO CENTRE OF EAR _____ CM
(18) PENIS OPENING TO CENTRE OF NAVEL _____ CM
(19) PENIS OPENING TO CENTRE OF ANUS _____ CM
(4) LONGEST MYSTACIAL VIBRISSA _____ CM
(20) VENTRAL THICKNESS OF EPIDERMUS _____ CM
(21) VENTRAL THICKNESS OF SUBCUTANEOUS ADIPOSE LAYER _____ CM
(22) LENGTH OF BACULUM (OS PENIS) _____ CM





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INFORMATION FROM HUNTS AND SURVEYS OF WALRUS (*Odobenus rosmarus*) IN NORTHERN FOXE BASIN, NORTHWEST TERRITORIES, 1982-1984

by

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ABSTRACT

Orr, J.R., B. Renooy, and L. Dahlke. 1986. Information from hunts and surveys of walrus (Odobenus rosmarus) in northern Foxe Basin, Northwest Territories, 1982-1984. Can. Manuscr. Rep. Fish. Aquat. Sci. 1899: iv + 24 p.

Walrus hunting in northern Foxe Basin was monitored during the summers of 1982, 1983 and 1984. Hunting techniques and effort were recorded, biological samples and measurements were collected from landed animals, and a boat and helicopter reconnaissance were done to obtain preliminary information on distribution and abundance. This report presents a summary of information collected during these hunts and surveys. Past and present hunting information is discussed, as well as trends in distribution and abundance.

Key words: hunt description; hunting effort; loss rate; morphometrics; utilization, marine mammal; pinniped.

RÉSUMÉ

Orr, J.R., B. Renooy, and L. Dahlke. 1986. Information from hunts and surveys of walrus (Odobenus rosmarus) in northern Foxe Basin, Northwest Territories, 1982-1984. Can. Manuscr. Rep. Fish. Aquat. Sci. 1899: iv + 24 p.

Durant les étés 1982, 1983 et 1984, on a observé la chasse aux morses dans le nord du bassin Foxe. Les techniques et l'effort de chasse ont été notés, on a recueilli des échantillons biologiques et des mesures sur les animaux capturés et on a effectué des inventaires préliminaires en bateau et en hélicoptère afin d'obtenir de l'information sur leur distribution et leur abondance. Ce rapport contient un résumé de l'information receuillie durant ces chasses et inventaires. On y discute de données sur la chasse dans le passé et sur celle d'aujourd'hui ainsi que des tendances dans la distribution et l'abondance du morse.

Mots-clés: description de la chasse; effort de chasse; taux de pertes; morphométrie; utilisation; mammifère marin; pinnipèdes.

INTRODUCTION

An unknown number of Atlantic walrus (Odobenus rosmarus rosmarus Linnaeus) inhabiting Foxe Basin year round are hunted annually by people from the communities of Igloolik and Hall Beach (Fig. 1). Most intense hunting occurs between July and September, when walrus haul-out on floating pack ice east of the communities.

Studies were conducted on the Foxe Basin population in the late fifties and early sixties (Mansfield 1958; Loughrey 1959; Perey 1961; Anders 1965) but little work has been done since that time. In response to indications of increased hunting pressure in the late seventies, the Department of Fisheries and Oceans (DFO) implemented yearly restrictions on all walrus hunting communities. An annual limit of four walrus per Inuk hunter was enacted into the regulations in 1980 (Walrus Protection Regulations 1983) except for the communities of Coral Harbour, Arctic Bay, Sanikiluaq and Clyde River which preferred community quotas. The quotas were based on historical harvest levels and discussed with the communities before they were established (D. Dowler, DFO, Yellowknife, NWT, personal communication).

After meeting with the Hunter and Trapper Associations (HTA) from Hall Beach and Igloolik in the spring of 1982, DFO initiated a three year summer program to monitor walrus hunting and collect data. DFO representatives accompanied walrus hunters from Igloolik recording their techniques, effort, hunting areas and collecting data from walrus killed. In addition a local boat reconnaissance and a helicopter reconnaissance were conducted in 1982 and 1983 respectively, to obtain preliminary information on the distribution and abundance of the northern Foxe Basin walrus population.

This report presents information gathered during the three year program. Hunt descriptions and effort are presented, and morphometric measurements of the animals samples are listed in tabular form. Summaries of both surveys are presented, along with illustrations of survey routes and marine mammal sightings. Changes in hunting methods, loss rates and annual harvests are discussed along with distribution and abundance information.

STUDY AREA

Foxe Basin is a relatively large but shallow body of water located north of Hudson Bay (65°00'N to 70°00'N) and west of Baffin Island (73°00'W to 83°00'W), in the Northwest Territories (Fig. 1). The water depth in most areas is less than 100 meters and less than 50 meters in much of the northern portion (Grainger 1959). Strong currents move eastwards out of Fury and Hecla Strait, then southwards along Melville Peninsula, through Foxe Channel to Hudson Strait. Aside from various leads and a polynya in its northwest corner, Foxe Basin is ice covered for at least eight months a year. Sea ice forms in early November and usually begins to thaw in late June or early July. Fast ice may hold until early August (Markham 1981). Once the ice begins to break up it moves with the tides, currents and wind.

Most of the land surrounding northern Foxe Basin is made up of sedimentary material. Raised gravel beaches and lowlands are common both on the mainland and the several islands situated in the eastern portion of the Basin. Sediments are continually being discharged into eastern Foxe Basin from the many rivers flowing from Baffin Island (Survey and Mapping Branch 1973). Discharged sediments settling to the bottom could provide a desirable habitat for benthic organisms (Ellis 1960) and evidently suitable feeding areas for walrus.

MATERIALS AND METHODS

MONITORING THE HUNT

All activities associated with hunting were observed and documented. Conversations were conducted with experienced walrus hunters to determine what factors influenced their decisions to hunt. Listening to hunters before an outing gave insights into the amount of planning that occurs before a hunt takes place.

Once the hunt began, information on equipment, hunting areas, animal selection, killing methods, butchering techniques and traditional procedures were recorded. The amount of fuel used, types of rifles, hunter preference for killing walrus on ice floes or in the water, number of walrus shot, the number retrieved and the amount of time spent on each outing were documented to determine hunting effort.

After butchering was completed, the preparation of meat for travel and its distribution, consumption and storage at Igloolik were recorded. Prices paid for raw ivory, ammunition and gas were obtained from the local Co-op manager.

MEASUREMENT AND SAMPLING OF THE CATCH

The sampling sheets used in 1982 and 1983-1984 are shown in Appendices 1 and 2 respectively. Standard body length (in a straight line from snout to tail) and circumference behind the foreflippers were measured (to the nearest centimeter) before the hunters started butchering.

Once butchering began tissue samples were collected as they became available. Approximately 250 grams of blubber, skeletal muscle, heart, liver and kidney were collected for pollutant and genetic studies. All samples were placed in individually labelled plastic bags and stored on ice, in a larger plastic bag. Testes or ovaries and uteri were also collected and placed in a 10% buffered formalin solution for later analysis of reproductive status.

After all the samples were obtained, tusk measurements were made to the nearest millimeter. Straight line lengths from tip to gumline and the circumference at the gumline were

taken before the hunters extracted the tusks from the skull. Lower jaws and eyes were collected for age determination, individually bagged and placed in the large bag with the other samples. Once back at Igloolik all the unformalized samples, were put in the community freezer. The frozen samples were placed in insulated boxes and shipped back to DFO, Winnipeg for analysis.

During the first year most hunters expressed a genuine interest in the program. To further enhance participation during the second and third years, a reward system was devised so that hunters could collect samples when DFO staff were not available. This not only increased the hunters' understanding in the program, but it also brought in several samples that would otherwise not have been obtained.

Meetings were held to instruct hunters how to take measurements and collect appropriate samples. Plastic bags were made available along with a length of string for taking measurements. Any hunters who could not be accompanied by a DFO representative were asked to take along the sampling material. Samples were brought to DFO field staff after a hunt, for inspection and payment. The samples were then labelled and frozen. Length and girth measurements were obtained from the knotted string.

BOAT RECONNAISSANCE

On 22 September 1982 a survey was conducted using a 6.7 m (22 ft) freighter canoe with a 35 hp outboard motor. A field of floating pack ice approximately 2.5 km by 10 km, located 10 km southeast of Igloolik, was circumnavigated at a distance of about 75 m from the ice edge (Fig. 2). The canoe first followed along the west side of the ice in a southeasterly direction until no walrus could be seen to the south. It then turned 180°, heading along the east side of the ice mass in a northwesterly direction. All walrus observed both in the water near the ice and on the ice were counted. A tally counter was used to keep a cumulative total of the numbers.

HELICOPTER RECONNAISSANCE

Ten hours of helicopter support was available through the Polar Continental Shelf Project (PCSP). Because walrus are gregarious ice associated animals and clumping was expected, a systematic survey did not seem appropriate with only 10 hours of flying time. Records from past hunts along with interview information obtained from Inuit walrus hunters were used to determine the areas most likely to be frequented by walrus during the month of August. From this information a tentative route was planned, taking into account ice cover and the location of fuel caches. Allowances were made for route deviation in the event that animals were encountered off the planned route. Salter (1979) gave insights into what reactions the walrus might have towards the helicopter. The survey was conducted on 19 August (7.4 h) and 20 August (3.5 h) 1983. The weather was calm and clear, giving maximum visibility. A Bell 206 Long Ranger Helicopter was used to fly the survey at ground speeds ranging from 145-160 $km \cdot h^{-1}$ (90-100 mph) and altitudes of 61-457 m (200-1500 ft) above sea level (ASL) but found 152 m to be the best for counting. One observer sat in the front next to the pilot and recorded the grid reference for each sighting using the aircraft's Omega navigation system, while the other two observers sat in the back, observing from each side.

On 19 August, the helicopter flew southeast to Arlagnuk Point, then followed the coast approximately five kilometers offshore to Pinger Point (Fig. 3). It then headed in a straight line to refuel at Hall Beach. Once refuelled it continued south until dense pack ice (>90%) was encountered. It then followed the edge of the pack southwest for several kilometers before heading northeast to the south end of South Spicer Island. A refuelling stop was made at North Spicer Island. The helicopter continued north to the southeast end of Rowley Island, then back to Hall Beach for more fuel. Finally a loop was flown from Hall Beach, along the west coast of Rowley Island to dense pack ice north of Koch Island, past the south end of Tangle Island and back to Igloolik.

The second part of the survey on 20 August lasted 3.5 h. A straight line was flown from Igloolik to the southeast side of Rowley Island. The helicopter then headed north over dense pack ice to Cape Thalbitzer where it was refuelled. Turning west, the helicopter flew past the north side of Jens Munk Island into Fury and Hecla Strait and then south to Igloolik, where the survey ended.

RESULTS

GENERAL HUNT DESCRIPTION

Hunting during July and August usually occurs several km east of Igloolik Island, around the area of Rowley Island (Fig. 1). Exact hunting locations vary with pack ice distribution and abundance. A staging area (camp) is established on the southeast side of Igloolik Island (Igloolik Point) in early July, since the floe edge is closest there, allowing hunters easier access to open water (Fig. 4). Normally in July large areas of open water are found east of Igloolik Island (Markham 1981). Walrus are usually encountered in the dense pack ice at the east and southeast periphery of the open water. By early August Turton Bay becomes ice free allowing hunters to leave directly from the town of Igloolik.

Hunting trips are dependent on the weather, occurring only during calm conditions. The decision to hunt is most often made in the early afternoon when the weather trend is most apparent. However, with 24 h of daylight in July, hunts can occur at any time of the day. Once the decision to hunt is made, canoes are prepared and are usually ready to go within the hour.

There are at least four men in the settlement of Igloolik who are highly respected for their knowledge of walrus hunting. They usually make the final decision on whether the hunt should take place from Igloolik Point during July and August. At least one of these men participates in any given hunt, directing and giving advice to the less experienced hunters.

Early summer hunts appear more organized than fall hunts. This probably stems from the fact that the more dedicated hunters do their hunting in July and August, leaving from Igloolik Point. They evidently spend more time planning the hunts than those who leave directly from the town in September. Walrus herds tend to be closer to Igloolik in the fall and more inexperienced hunters participate in the hunts without guidance from the experienced men.

The majority of hunters from Igloolik use cedar strip (freighter) canoes 6.7-7.3 m (22-24 ft) long, powered by 20 to 90 hp outboard motors. Standard equipment taken on hunts includes a harpoon with line and float, a variety of rifles, ammunition, knives, grub box with basic food supplies, seal hook, spare motor parts, tools, tarpaulins, caribou hides and fuel for the motor and Coleman stove. Two-way radios, available through the HTA, are sometimes taken along as well. At least two hunters occupy each canoe with one or two boys often accompanying them, but not actively participating in the hunt until their mid-teens.

Hunts begin with a search, which may take from one to five hours. If walrus are plentiful several groups may be passed before a suitable walrus is selected and killed. The sex and size of walrus taken depends on the hunters' preference; however, larger tusked animals (male or female) are most commonly taken.

Walrus hauled out on large flat ice pans are the most desirable since they can be easily approached, killed and then butchered. Comparatively few walrus are taken in the water as there is more danger and work involved in taking these animals. A walrus in the water must first be wounded, usually by shooting it in the abdomen when it surfaces for air. It then must be harpooned before a killing shot can be made, because a walrus generally sinks after death. Once the walrus is killed it is usually hauled up on a larger, flat ice pan for butchering. This procedure requires several men or a block and tackle, which are not always available. As a result walrus are sometimes butchered in the water alongside the canoe. Carcasses are not always fully utilized when butchered in the water because it is more difficult to get at all the usable parts.

Walrus reactions to boats and gun shots are unpredictable. One group may be approached to within 10 m without becoming alarmed, while another group may disperse into the water before a boat comes within 50 m. Hunters keep a close watch on walrus once they enter the water, especially if they are wounded. Igloolik hunters have reported cases where boats were rammed or punctured by walrus attacks. Hunters must sometimes scare off live walrus remaining on ice pans, reluctant to leave a killed companion. In such cases ice chunks, anchors, or harpoon shafts are thrown at them to scare them off.

Butchering can take up to 2 h when all useable parts are taken. The amount of the carcass which is utilized depends on the hunter, weather conditions and time of year. Usually all but the vertebrae, head (minus the tusks) and some viscera are taken back for human consumption or dog food. Butchering procedures are described in detail in Appendices 3 and 4.

Stomach contents are sometimes eaten during butchering, depending on the contents. The stomach is cut open, the contents rinsed in water and eaten raw. Laryngeal cartilage is also carved out and eaten raw during butchering or is taken back for family members.

During a 1982 hunt a walrus was shot on an ice pan and after close examination the hunter felt it was diseased and took only the head with tusks. Head chopping may also occur when bad weather is threatening or in September when the less dedicated hunters are participating in the hunt, but based on our observations, this seems to be a rare practice with Igloolik hunters.

Other marine mammals may be hunted incidentally during walrus hunts. The bearded seal (Erignathus barbatus) and ringed seal (Phoca hispida) are most commonly taken, but beluga (Delphinapterus leucas) and narwhal (Monodon monoceros) are taken as well. Bowhead whales (Balaena mysticetus) are occasionally sighted but they are not hunted. Polar bears (Ursus maritimus) are also seen, but are usually hunted in the winter.

Walrus meat is either cached on Melville Peninsula or on islands in northwestern Foxe Basin, or taken back to Igloolik. The meat is either boiled and consumed fresh or buried in a gravel ridge and consumed later (see Appendix 3). All the meat from fall hunts is frozen and consumed throughout the winter. Meat buried in the summer is dug up in early spring, thawed slightly and eaten raw. The Inuit call the aged meat, organs and blubber "Igoonuq" and consider it a delicacy.

HUNTING EFFORT AND LOSSES

Information pertaining to hunting effort was recorded from 15 hunts carried out in July and August during 1982-1984 (Table 1). The amount of fuel used and number of shots fired during each hunt was recorded in 1982. Participation in hunts varied from 2-24 men with an average of 10 per hunt. Aside from one hunt which lasted 45 h, due to bad weather and mechanical problems, most hunts lasted from 8 to 16 h. Most of the time was spent travelling and butchering. With almost 24 h of sunlight in July darkness is not a limiting factor towards the length of time spent hunting.

During the six monitored hunts in 1982, fuel consumption ranged from 68-114 L (15-25 gal) per canoe. These figures represent the consumption of a 35-50 hp outboard motor, which

are most commonly used by Igloolik hunters. Oil mixed in with the gas would amount to 1-3 L (3-5 pt).

An average of two shots were fired at each walrus in 1982. The most commonly used calibres were 0.303, 30/06, and 0.308. The firing distances ranged from 10-30 m (33-100 ft).

A total of 124 walrus were shot at during the three year study. Forty of these animals were lost before a harpoon could be successfully attached. There was an obvious preference for taking walrus hauled out on ice pans (75%) since effort is significantly reduced by taking hauled out animals. There were several cases however, when animals shot on ice pans either fled to the water before death or slipped off after death and were lost. Of the 20 walrus recorded as killed in the water, approximately 12 were initially wounded on an ice pan and subsequently killed and harpooned in the water.

CARCASS UTILIZATION AND COST OF OBTAINING MEAT

To estimate carcass utilization Fay's (1982) figures for the relative weights of body parts of the Pacific walrus (O. r. divergens Illiger) were used with Loughrey's (1959) average weight from the Atlantic walrus. This extrapolation suggests that about 70% of the total body weight is utilized during a typical hunt; for example, from an Atlantic walrus weighing 660 kg, a hunter would typically take about 460 kg.

By adding up the costs involved in a typical hunt, a cost per kilogram of meat can be estimated. Capital costs for boats, motors, rifles, etc. weren't included in the calculation since these items are used for other activities besides walrus hunting.

Gas at $0.65 per litre x 114 =	$74.10
Oil at $2.00 per litre x 3 =	6.00
Bullets at $0.75 per shell x 2 =	1.50
Misc. (food, stove gas)	10.00
Total cost	$91.60

$91.60 ÷ 460 kg = $0.20

Based on these figures, it would cost ≈$0.20 for each kilogram of walrus flesh. In addition, the hunter would probably obtain two tusks weighing, on the average, 1.1 kg each which could be sold as raw ivory at the Co-op for $39.70 per kg (Igloolik Coop manager personal communication). Therefore, if a walrus hunter successfully lands a walrus he could sell the tusks to pay off the majority of his costs and have a supply of country food for himself and his dependents.

SAMPLES AND MEASUREMENTS

Samples collected for heavy metals analysis, reproductive status and histological analysis are being examined by others and results will appear in separate reports. A list of body measurements taken are presented in Table 2 for males and Table 3 for females. Male body lengths ranged from 132-374 cm with a mean length of 295 cm, total body lengths for females ranged from 122-296 cm with a mean of 249 cm (Tables 2 and 3, Fig. 5). A ratio of 67 to 31, males to females suggests a preference towards taking males.

Tusk length measurements are illustrated in Fig. 6. The external tusk length of males ranged from 80-440 mm with a mean of 279 mm (Table 2). External tusk length of females ranged from 28-396 mm with a mean of 253 mm (Table 3). Tusk circumference at the gum line is illustrated in Fig. 7, having a mean of 162 mm for males and 125.5 mm for females. Correlation between tusk length and circumference at the gum line are shown in Fig. 8a for males and Fig. 8b for females. Although tusk lengths are similar, there is a noticeable difference in the thickness of tusks between the two sexes. Aside from body size, hunters preference for male walrus may be attributed to the fact that it is the weight of the tusk that determines the amount of money a hunter receives.

BOAT RECONNAISSANCE

During the survey 1356 walrus were counted, both hauled out and swimming in the general area (Fig. 2). Because the walrus were heavily concentrated on some of the larger ice floes some were likely not included in the count. All sizes of walrus were present in the area. Cows and calves appeared more frequently towards the southern section, while larger walrus (probably males) appeared more frequently in the northern section.

HELICOPTER RECONNAISSANCE

The aerial survey was flown over a two day period, with 75% flown on the first day (Fig. 3). The majority of walrus sightings (>99%) were made on the first day, between the south end of Rowley Island and Cape Jermain on Melville Peninsula. On the second day the few walrus seen (6) were located on the east side of Rowley Island.

Approximately 85% of all sightings were of hauled-out animals. Since the sea was relatively calm, the Inuit observers aboard felt that sightability of swimming animals was good. They also felt the high ratio of hauled out to swimming walrus was a result of several days of inclement conditions prior to the survey, since walrus don't haul-out during bad weather.

At an altitude of 152 m and a ground speed of 144 $km \cdot h^{-1}$, walrus showed little reaction to the helicopter until it came within 0.4 km of them. This allowed the observers time to do a total count and most times confirm the lack of or presence of calves, before the walrus fled to the water. Calves were most abundant between Rowley Island and North Spicer Island. They were also present west and southwest of Rowley Island and along the dense pack ice northeast of Cape Jermain.

Other marine mammals observed during the survey included; 3 bearded seals, 17 belugas, 16 bowhead whales, and 5 polar bears (Table 2).

DISCUSSION

HUNTING

The Inuit of Foxe Basin have historically depended on the walrus as a major food source, both for themselves and their dogs. The difficulties and dangers involved in walrus hunting were reduced considerably with the introduction of boats and rifles. Prior to 1930 walrus were typically killed through the ice with lance and harpoon, primarily in the fall when new ice was forming (Loughrey 1959). Now walrus hunting is most commonly done from boats using high powered rifles. Large whale boats (10-15 m) or Peterheads were introduced first, originally powered by sail and then by inboard motors. In the 1960's these boats were replaced by smaller more manouverable canoes (Beaubier 1970). During our study hunting was done almost exclusively from canoes.

Anders (1965) reported that the most common outboard motor used during his study in the early 1960s was the 9.5 hp. Beaubier (1970) indicated a shift to motors of 18 and 20 hp in the late sixties. Our observations showed that the 20 hp outboards are seldom used and that 35-50 hp motors are the most commonly used outboards. Seventy and 90 hp motors are becoming more common and one man was observed walrus hunting with a 235 hp outboard on an aluminum boat. Faster outboard motors have the advantage of decreasing travelling time, especially when a canoe is heavily loaded. This would be advantageous when encountering bad weather on open seas. However increased horsepower means a rise in the initial purchase cost and in gas consumption.

The calibre of rifles used for walrus hunting has also increased over the years. In the early sixties 0.22 and 0.30-30 calibre rifles were typically used (Anders 1965). Beaubier (1970) noted the 0.222, 0.243, and 0.30-30 were the most common during the late sixties. In the eighties 30/06, 0.303 and 0.308 calibre rifles are most often used. Again, initial costs are greater but the larger calibre rifles have more killing power. Presumably this would increase the chances of killing animals instantaneously, reducing the losses due to wounded animals escaping. The range from which walrus are shot (10-20 m) appears to have remained constant over the years (Beaubier 1970).

The act of killing walrus solely for their ivory tusks has been suspected through the years but few observation of this in the area of Foxe Basin have been documented in the literature. Anders (1965) suspected that indiscriminate shooting was occurring because raw ivory was being sold directly to people at Distant Early Warning (D.E.W.) line sites. We did not see or hear of any hunters hunting only for ivory during our studies, however hunters may have been reluctant to do this in our presence.

LOSS RATE AND ANNUAL HARVEST

Inuit hunters regard losses as a normal occurrence when hunting walrus or other marine mammals. The act of shooting before harpooning marine mammals is responsible for the greatest amount of losses. Walrus sink soon after death and must be harpooned as quickly as possible. Because a wounded walrus can be very aggressive, hunters are somewhat reluctant to get too close to them. The possibility of having a walrus puncture or capsize their canoe is a legitimate hinderance. Considering the maximum effective throwing distance of a harpoon is 7.5 m (Beaubier 1970), successfully harpooning a walrus can be a dangerous undertaking.

If 40 walrus of 124 were lost this means that 32% or approximately, 1 in every 3 walrus removed from the population is not utilized. The most realistic way of reducing losses would be to urge hunters to use more discretion when choosing a walrus to shoot. If they restricted their targets to hauled-out walrus away from the edge on large flat ice floes, losses could be reduced.

Loughrey (1959) estimated the average annual take (loss rate not included) in the Igloolik area during the fifties to be approximately 425 walrus. He indicates that the trend seemed to be towards less hunting. Loughrey's information came from RCMP reports and a questionaire that he distributed during his study. He calculated the overall loss rate for the eastern Arctic region at one walrus lost in every three shot, which is consistant with our data. Therefore, multiplying his annual harvest number by his predicted loss rate would give a total average annual harvest of 637 walrus.

DFO marine mammal harvest statistics show an average annual harvest in northern Foxe Basin of 203 between 1973 and 1985; however no allowance is made for hunting losses in this figure (unpublished report, Winnipeg). Adding our loss rate of 32% would give a total number of 305 walrus taken from the population through hunting. Although DFO's information may be somewhat incomplete, there is a substantial difference between these figures and the earlier estimate reported by Loughrey (1959). Whether hunting has decreased over the last decade or whether the estimates of numbers taken through hunting has been calculated improperly over the years can not be determined.

DISTRIBUTION AND ABUNDANCE

Both Anders (1965) and Beaubier (1970) reported that the distribution of the walrus in northern Foxe Basin has changed since the colonization of Igloolik and Hall Beach. The disappearance of large herds along the east coast of Melville Peninsula has been attributed to increased boat traffic and hunting around the communities of Igloolik and Hall Beach. Beaubier (1970) indicated that summer hunting occurred in the Foster Bay area from 1930 to 1940, but by the 1950's walrus were no longer found there. The walrus were thought to have moved eastward, spending the summer months around the

Manning and Spicer Islands. Anders (1965) identified the area around the Koch, Rowley and Bray islands as having the largest summer concentrations. This is supported by the fact that all the hunts monitored during our study took place just west or southwest of Rowley Island. Also, the distribution of walrus sightings obtained during the 1983 aerial survey suggested a greater concentration of walrus on the east side of northern Foxe Basin.

Observations from the boat survey in September 1982 suggests a westerly movement in the fall. The number of walrus observed during the boat survey was approximately one half of what was observed during the helicopter survey the following year. Whether the other animals passed the Igloolik area sooner, later or at all is unknown.

The present size of the Foxe Basin walrus population is virtually unknown (Davis et al. 1980). Anders (1965), using Loughrey's (1959) annual increment rate of 15% per year and an annual catch of 700, predicted a total walrus population in Foxe Basin to be at least 4 700. Anders (1965) derived his estimate by incorporating several assumptions into his calculations. Firstly, he assumed that a total of 700 walrus were removed from the population annually. Secondly, he assumed that the 700 animals removed annually wasn't an excessive number and the population could maintain itself at that level. Thirdly, he assumed that 15% was an accurate representation of the annual recruitment rate. Mansfield (1958) suggested an annual rate of production of 8% for eastern Arctic walrus. However, due to the inadequate sample of the age structure of the population Mansfield (1973) later revised his estimate to 11%, which is closer to the birth rates estimated for the Pacific walrus (Fay 1982).

Without knowing the approximate number of animals in a population, it is difficult to determine the effect that hunting has on the population. Results from the 1983 helicopter survey produced a minimum number of 2 722 walrus. If the number, derived from the helicoper survey is multiplied by the recruitment rate of 11-15%, a minimum annual increment of 300-408 animals would be expected. However, the helicopter survey only represents a portion of the Foxe Basin population and can only supply minimum estimates of the walrus present in the area.

RECOMMENDATIONS

In order to implement a proper management strategy, several questions have yet to be answered. Considering that the existing information on the species is limited and that the hunting pressure on the stock is relatively high, it is important that studies in Foxe Basin continue. Without information on stock size, reproductive rate and effects of hunting, assessment of the population's status can not be made. With this in mind we recommend the following:

1. that the walrus hunting restrictions of 4 per hunter for the communities of Igloolik and Hall Beach be maintained until more information on stock status is available.

2. that intensive surveys in Foxe Basin be conducted, to determine the size and composition of the walrus population.

3. that seasonal hunting methods, harvest levels and predicted loss rates be further studied, by continuing to monitor the hunting activities of Igloolik and Hall Beach walrus hunters.

4. and that resource users be given the opportunity to understand and participate in the management of the Foxe Basin walrus stock, by:

   a) summarizing the results of this study and translating them into Inuktitut so that it is available to the walrus hunters,

   b) presenting the results to residents of the communities of Igloolik and Hall Beach through community meetings, which would include discussions of loss rates and ways of reducing them,

   c) ensuring that local HTAs are kept well informed and participate in future studies in the Foxe Basin area.

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Table 1. Hunting effort during organized walrus hunts, northern Foxe Basin, during July and August, 1982-1984.

Year/ Hunt #	Number of Hunters	Number of Canoes	Total Gas (L) Used	Time Spent Hunting (h)	Number of Walrus			Walrus Taken		Total No. of Shots Fired
					Shot	Retrieved	Lost	On Ice	In Water	
82/1	7	3	318.2	14.5	7	4	3	3	1	15
82/2	11	5	600.5	16.5	10	4	6	3	1	15
82/3	12	6	522.8	11.5	10	8	2	6	2	18
82/4	4	2	295.5	16.0	2	2	0	1	1	8
82/5	4	3	204.6	14.0	4	3	1	1	2	14
82/6	14	6	454.6	11.0	14	7	7	5	2	30
83/1	10	5		45.0	7	6	1	3	3	
83/2	9	5		9.0	5	2	3	2	0	
83/3	7	4		13.5	6	5	1	5	0	
84/1	10	4		10.0	6	6	0	5	1	
84/2	19	7		12.5	10	8	2	7	1	
84/3	7	3		9.0	10	6	4	5	1	
84/4	24	8		13.5	13	9	4	6	3	
84/5	14	6		12.0	19	13	6	11	2	
84/6	2	1		10.0	1	1	0	1	0	
Total 15	154	68	2359.8	218.0	124	84	40	64	20	100
Mean	10.0	4.5	399.3	14.5	8.3	5.6	2.6	4.3	1.3	16.7
Percent					100	68	32	75	25	

Table 2. Body measurements taken from male walrus 1982-1984.

LENGTHS			TUSK CIRCUMFERENCE (MM)	
	TUSKS (MM)			
TOTAL (CM)	LEFT	RIGHT	LEFT	RIGHT
308	308	306	170	168
300	255	.	170	170
282	279	284	173	179
.	.	.	.	.
299	314	343	172	162
292	280	270	180	180
310	295	314	165	167
288	320	325	.	.
322	320	335	180	175
322	280	280	180	160
320	320	310	200	200
370	165	165	155	160
305	350	330	160	165
315	.	.	.	.
293	243	245	178	180
374	340	363	182	185
303	203	204	144	148
231	123	80	110	105
341	322	340	163	164
290	235	272	.	.
274	172	187	116	118
285	.	.	.	.
278	.	.	.	.
266	.	.	.	.
298	.	.	.	.
301	.	.	.	.
278	189	205	110	115
279	163	180	136	120
313	.	170	.	195
281	176	172	127	125
296	261	262	171	164
302	.	.	.	.
307	.	.	.	.
283	.	.	.	.
301	.	.	.	.
.	.	.	.	.
297	344	307	174	.
.	.	.	.	.
309	430	440	200	215
286	230	195	170	165
305	350	350	200	210
326	270	270	160	155
304	260	295	145	145
292	265	275	175	165
289	290	290	165	145
332	355	400	170	170
267	270	260	145	150
278	300	300	160	165
132	.	.	.	.
295	310	295	180	166
280	310	305	151	155
272	285	270	120	115
283	190	195	136	140
233	326	330	182	181
303	291	270	170	175
296	295	285	175	170
274	260	220	155	151
286	320	340	185	170
305	.	.	.	.
279	.	.	.	.
313	330	295	170	170
302	340	330	180	170
312	415	385	185	190
277	230	210	135	125
311	.	.	.	.
300	.	.	.	.
MEAN 294.4603	280.1915	277.7447	162.8889	161.5111
STANDARD DEVIATION 31.81248	64.79387	69.78584	22.8358	24.69047
MINIMUM 132	123	80	110	105
MAXIMUM 374	430	440	200	215
STANDARD ERROR 3.982799	9.451157	10.17931	3.40413	3.680638

Table 3. Body measurements taken from female walrus 1982-1984.

	LENGTHS			TUSK CIRCUMFERENCE (MM)	
		TUSKS (MM)			
	TOTAL (CM)	LEFT	RIGHT	LEFT	RIGHT
	283	355	360	125	128
	261	275	280	120	120
	.	245	228	105	100
	175	28	28	.	.
	270	137	230	130	120
	262	382	.	135	135
	122	.	.	.	.
	270	280	300	135	125
	.	.	.	.	.
	.	298	296	114	115
	296	396	384	150	153
	295	258	270	140	145
	241	.	.	.	.
	230	.	.	.	.
	272	.	.	.	.
	291	339	339	140	.
	259	235	220	110	115
	271	320	320	130	130
	175	40	30	.	.
	265	270	280	.	.
	270	240	290	165	120
	275	250	255	140	140
	290	270	320	150	140
	257	315	330	120	115
	279	285	295	115	110
	140	.	.	.	.
	257	211	115	105	105
	220	235	225	110	110
	273	265	395	182	181
	271	.	.	.	.
	205	85	90	60	60
MEAN	249.1071	250.5833	255.6522	127.6667	123.35
STANDARD DEVIATION	45.88984	95.19313	101.9918	25.12038	23.97866
MINIMUM	122	28	28	60	60
MAXIMUM	296	396	395	182	181
STANDARD ERROR	8.672364	19.43122	21.26676	5.481716	5.361792

Table 4. Summary of helicopter reconnaissance, showing numbers and location of all species sighted, Northern Foxe Basin 1983.

Date/ Time	ASL Altitude (m ASL)	Location Latitude	Longitude	Species	Number
19/August					
10:13	457	68 31	80 58	Beluga	2
10:25	213	68 22	80 44	Walrus	73
10:42	61	68 13	81 05	Walrus	113
10:45	61	68 12	81 13	Walrus	61
10:49	61	68 10	81 17	Walrus	310
10:52	61	68 09	81 22	Walrus	11
10:56	152	68 04	81 31	Walrus	9
11:06	61	67 54	81 35	Walrus	1
11:36	152	67 51	81 29	Beluga	1
12:40	152	68 31	78 42	Polar Bear	2
14:10	61	68 45	78 34	Walrus	37
14:15	61	68 46	78 40	Walrus	113
14:20	61	68 51	78 37	Walrus	327
14:25	122	68 52	78 30	Walrus	166
14:35	152	68 51	78 48	Walrus	190
14:40	61	68 49	78 53	Walrus	140
14:45	122	68 47	79 54	Walrus	23
14:47	122	68 47	78 59	Walrus	27
15:00	152	68 49	79 43	Walrus	422
15:05	152	68 48	79 46	Polar Bear	1
15:05	152	68 48	79 46	Walrus	3
15:10	152	68 48	79 55	Walrus	59
15:15	152	68 43	80 00	Walrus	6
15:20	152	68 44	80 24	Walrus	42
15:25	152	68 38	80 24	Walrus	79
15:30	152	68 37	88 29	Polar Bear	1
15:35	152	68 37	88 29	Walrus	56
15:37	152	68 37	88 32	Walrus	46
15:40	152	68 37	80 33	Walrus	46
17:13	152	68 55	80 46	Walrus	6
17:22	152	68 55	80 18	Walrus	95
17:26	152	68 56	80 01	Walrus	43
17:30	152	68 56	79 50	Walrus	40
17:32	152	68 56	79 54	Walrus	66
17:35	152	68 58	79 32	Walrus	96
17:40	152	69 00	79 29	Walrus	1
17:54	152	69 15	79 08	Walrus	5
18:02	152	69 25	78 55	Walrus	1
18:04	183	69 25	78 54	Walrus	2
18:06	183	69 28	78 58	Beluga	13
18:06	183	69 28	78 58	Walrus	1
18:06	183	69 28	78 58	Bowhead	1
18:16	152	69 28	79 21	Bearded Seal	1
18:30	152	69 19	80 01	Bearded Seal	1
20 August					
11:45	152	68 56	78 28	Walrus	1
11:52	152	69 08	78 21	Walrus	5
12:07	152	69 13	78 16	Polar Bear	1
12:17	152	69 28	78 17	Bearded Seal	1
15:10	305	69 39	81 39	Bowhead	2
15:12	305	69 37	81 39	Bowhead	1
15:15	305	69 37	81 44	Bowhead	5
15:20	152	69 37	81 45	Bowhead	3
15:30		69 36	81 45	Bowhead	4

Total August 19		Total August 20	
Walrus	2716	Walrus	6
Polar Bear	4	Polar Bear	1
Bearded Seal	2	Bearded Seal	1
Beluga	16	Bowhead	15

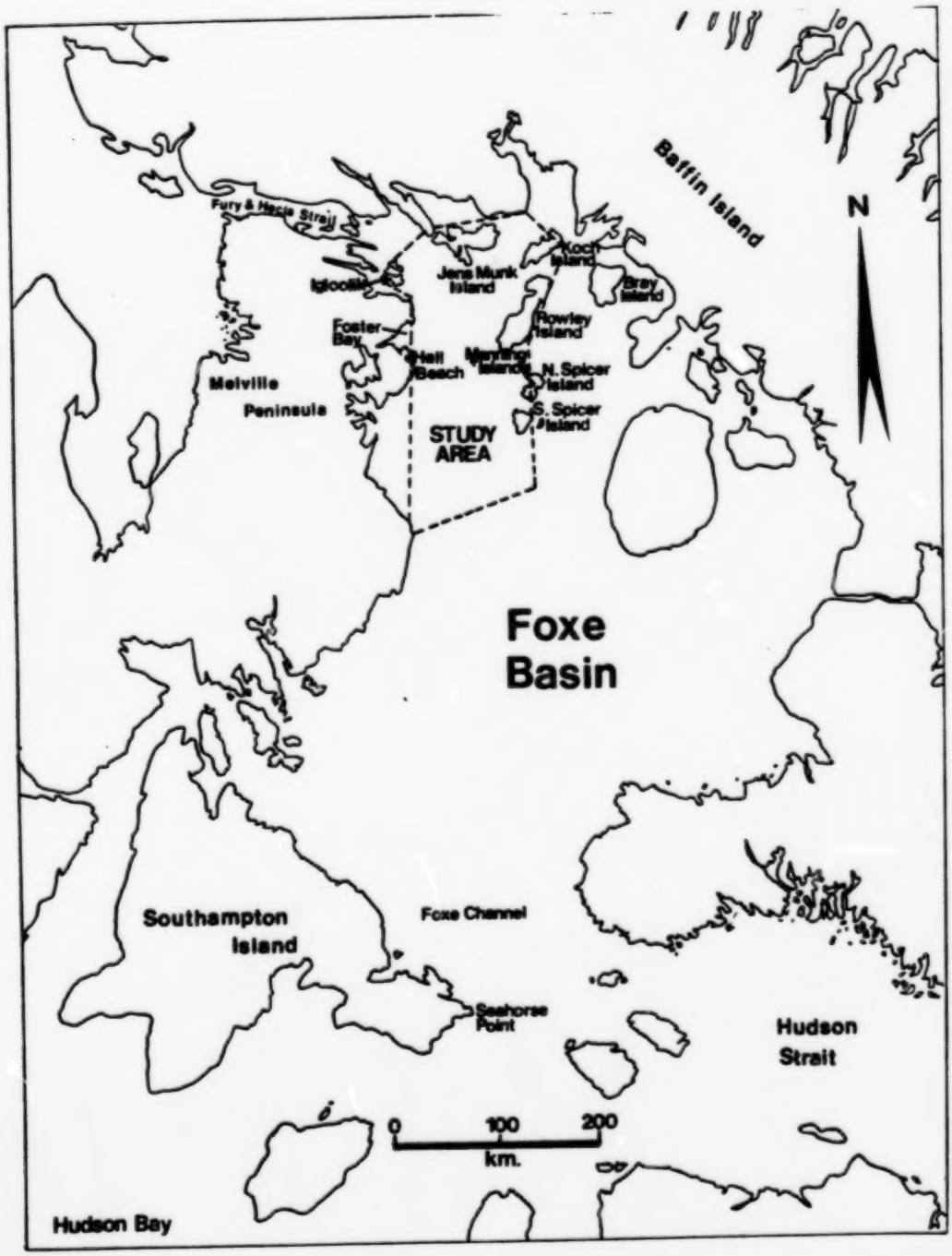


Fig. 1. Map of Foxe Basin area showing place names and the study area.

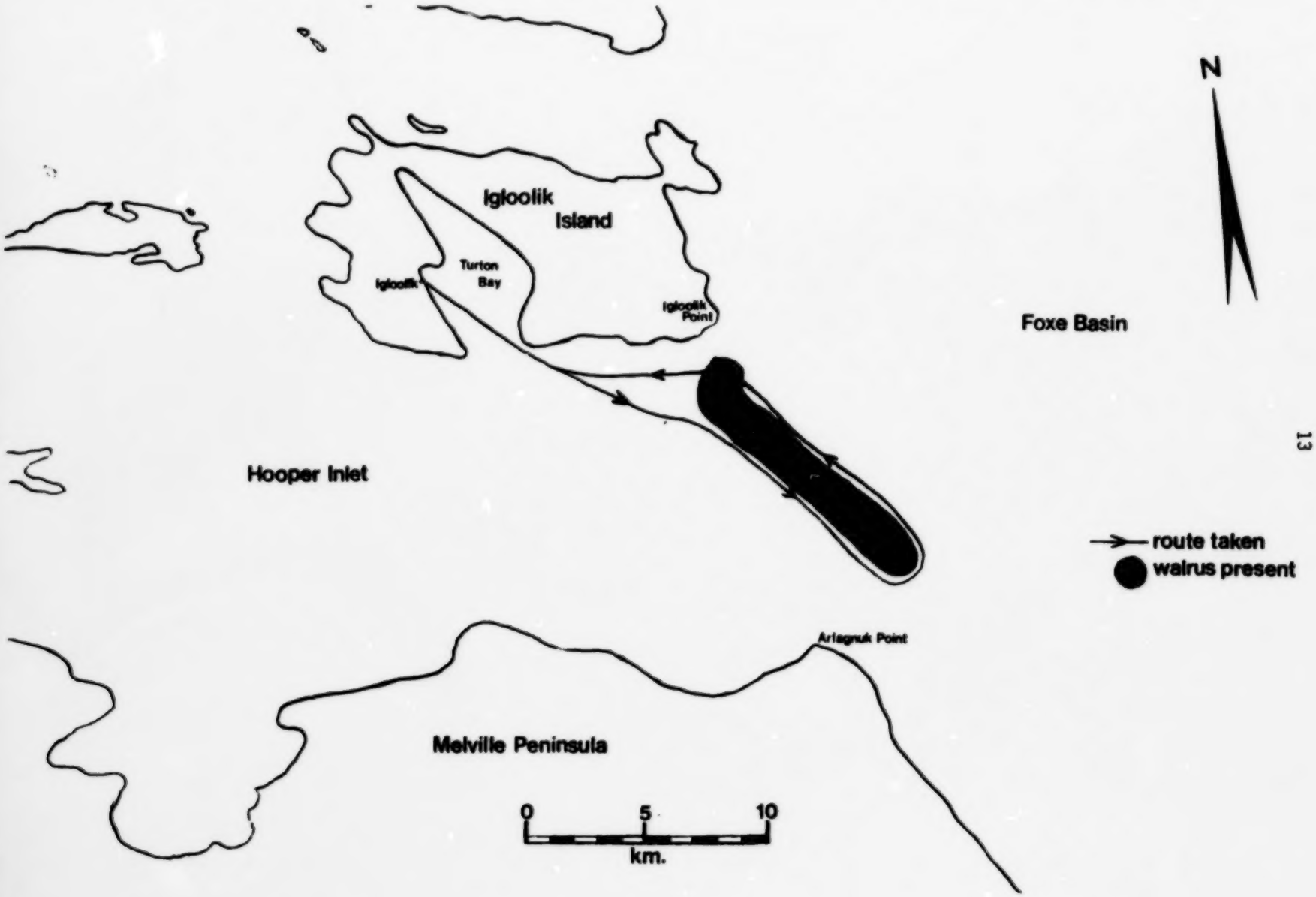


Fig. 2. Route taken during 22 September boat reconnaissance, showing location of hauled out walrus.

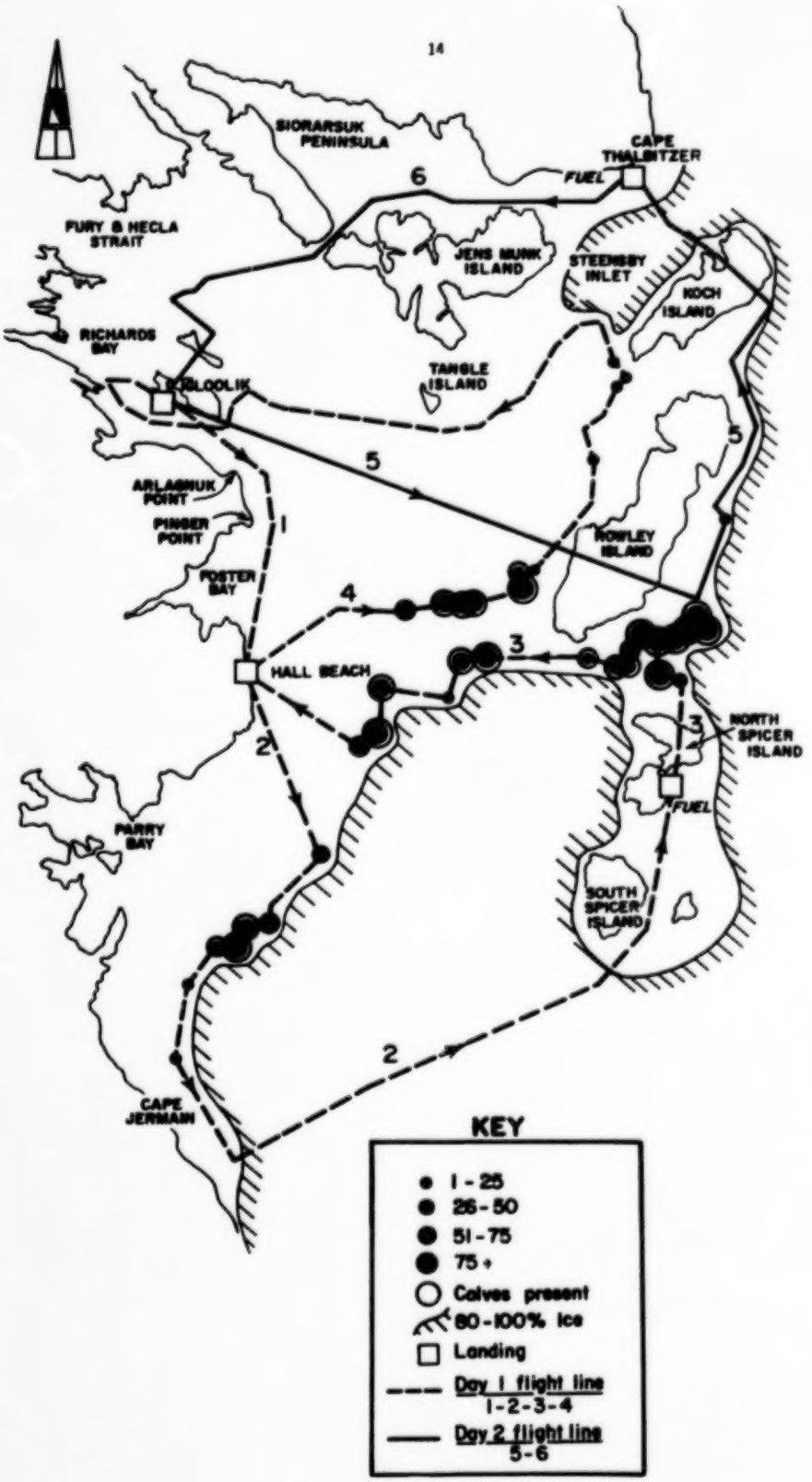
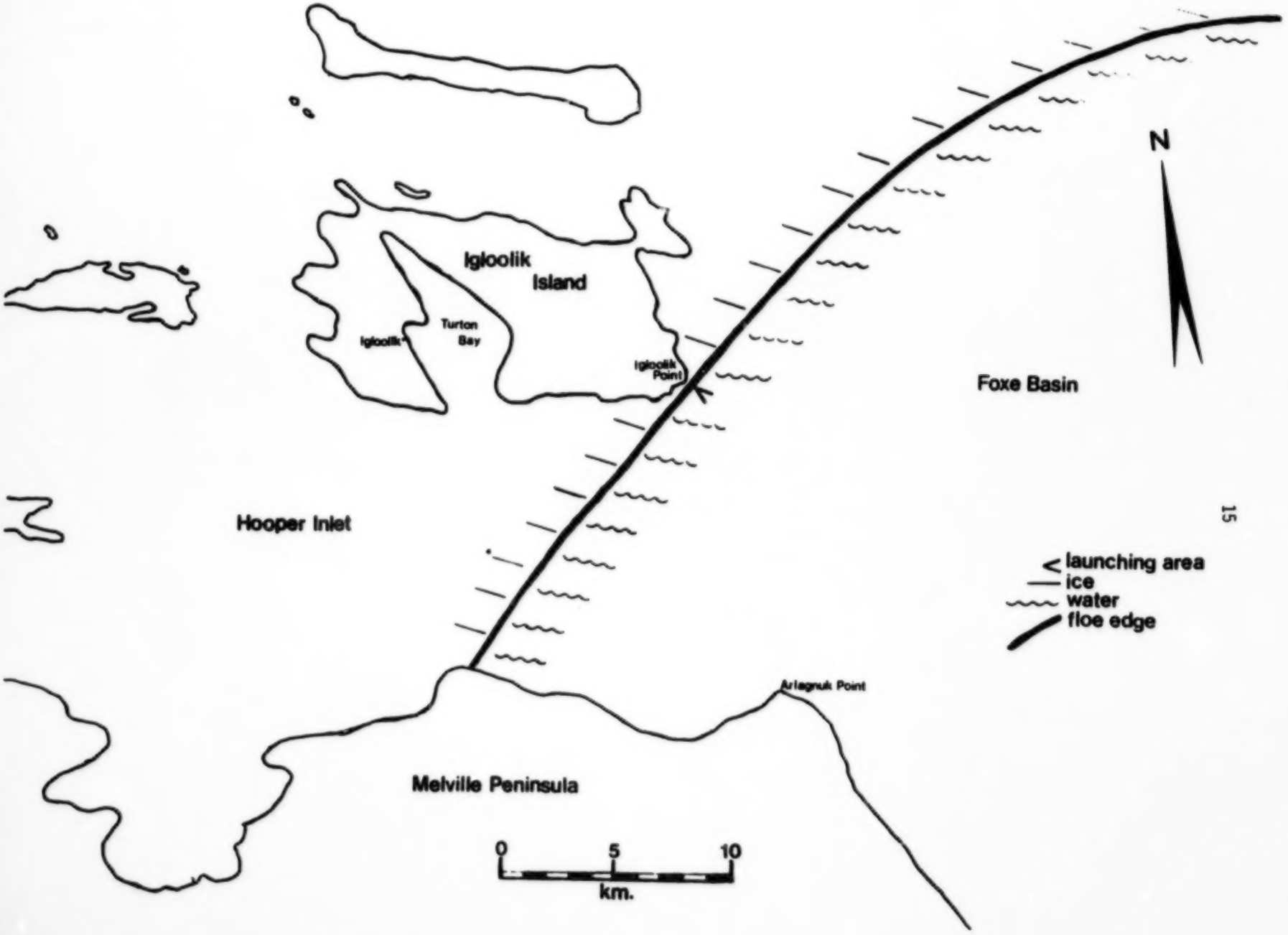


Fig. 3. Flight path of helicopter reconnaissance, flown on 19 and 20 August, showing walrus concentrations.


Igloolik
Island
Igloolik
Turton
Bay
Igloolik
Point
N
Foxe Basin
Hooper Inlet
launching area
ice
water
floe edge
Arlagnuk Point
Melville Peninsula
0
5
10
km.

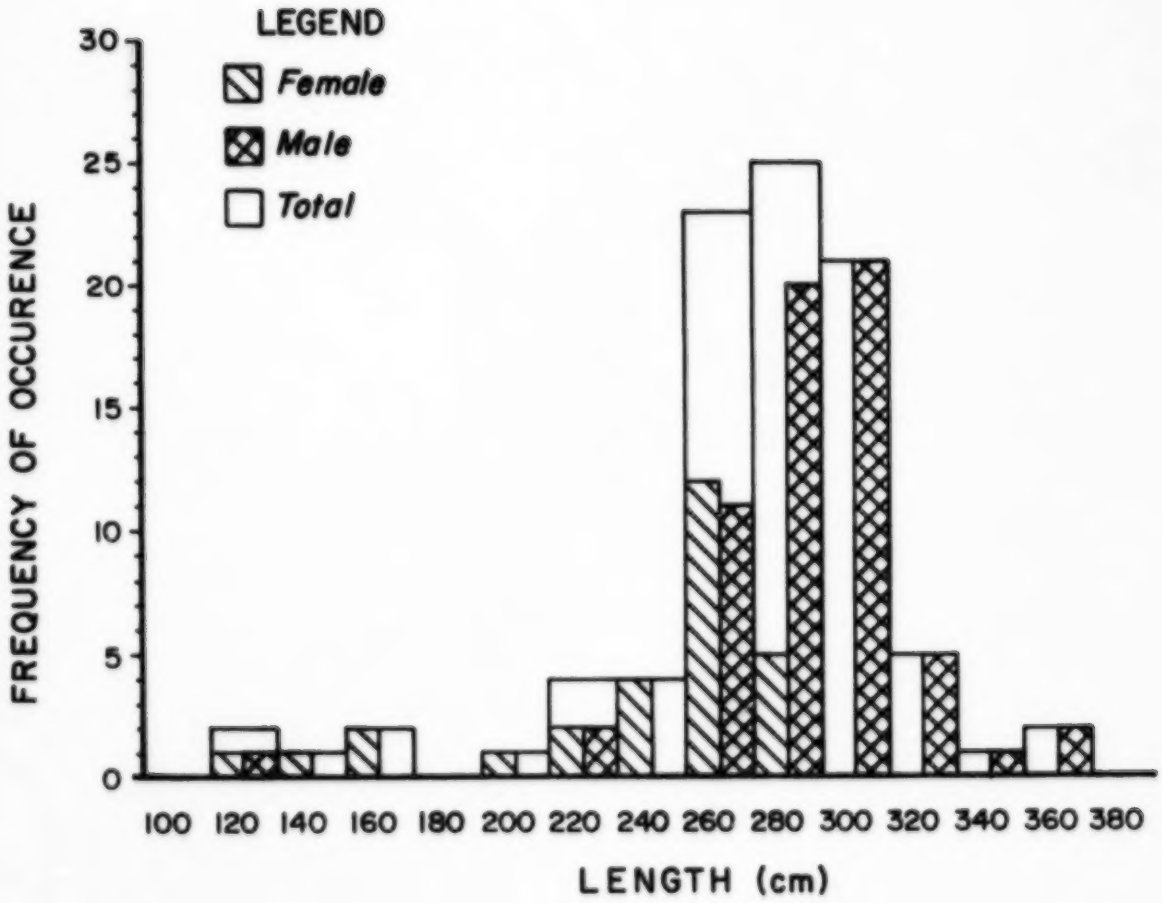


Fig. 5. Total body lengths of harvested walrus 1982-1984.

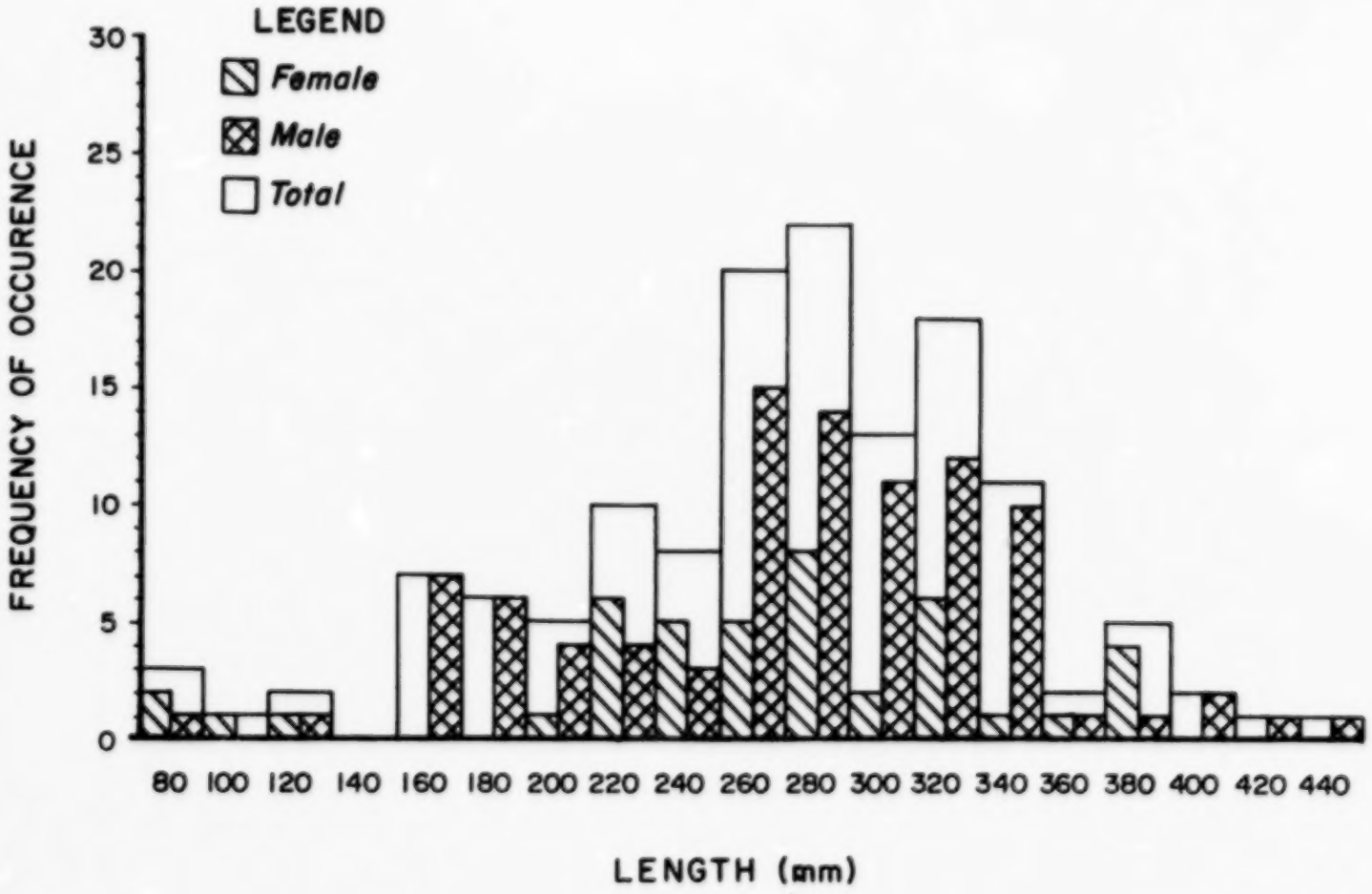


Fig. 6. Total tusk lengths of harvested walrus 1982-1984.

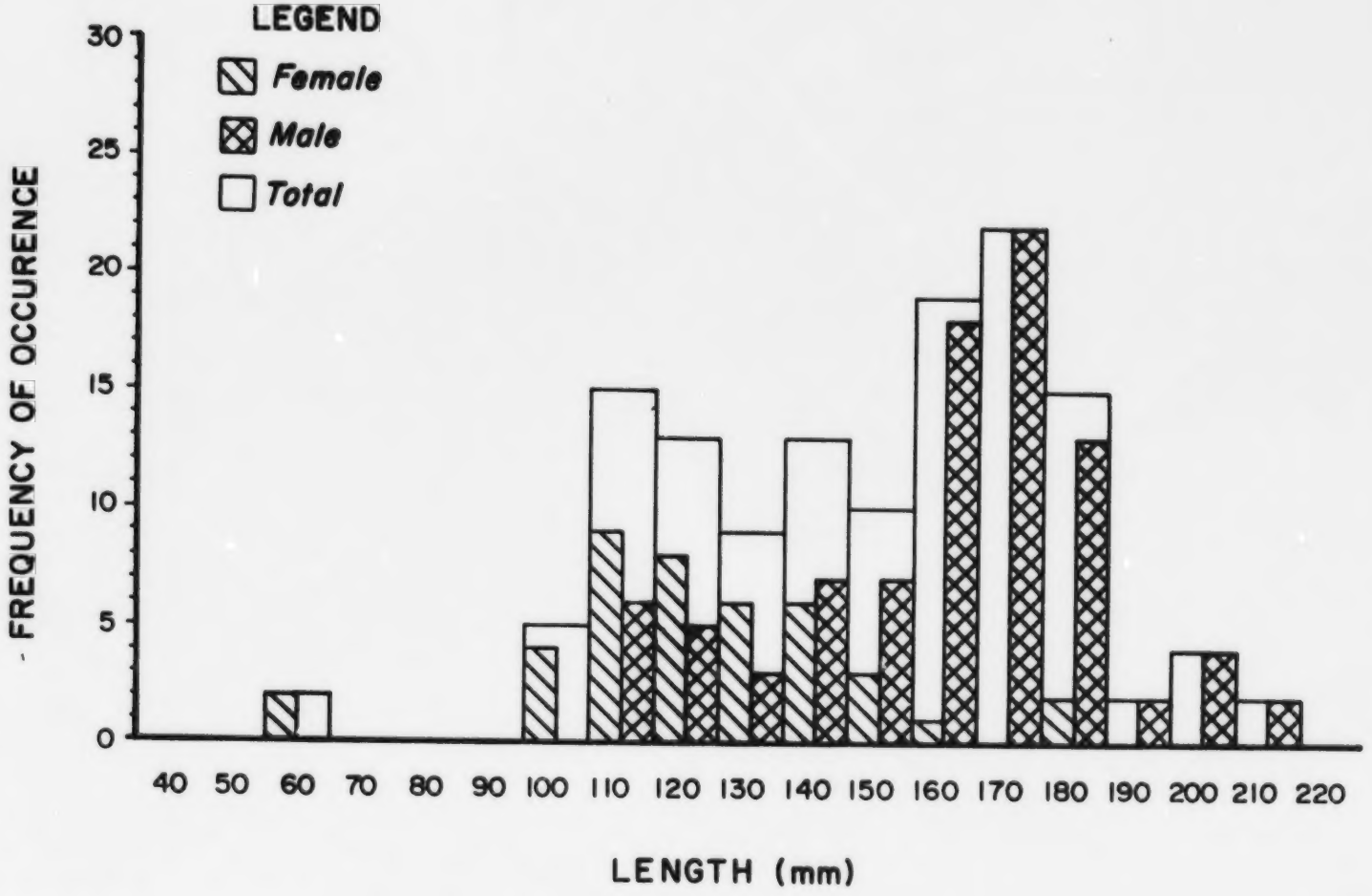


Fig. 7. Tusk circumference of harvested walrus 1982-1984.

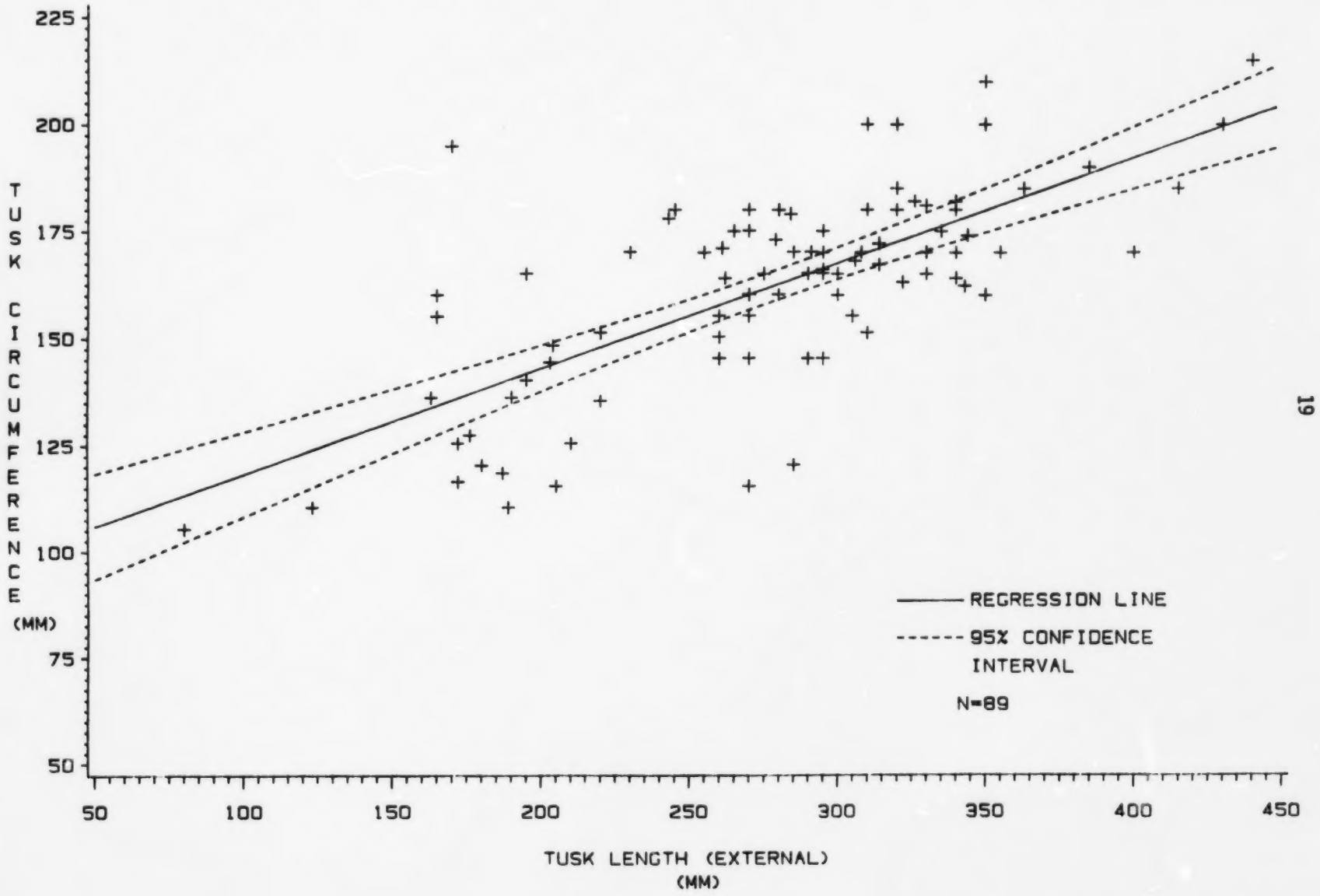


Fig. 8a. Tusk circumference vs tusk lengths of harvested male walrus 1982-1984.

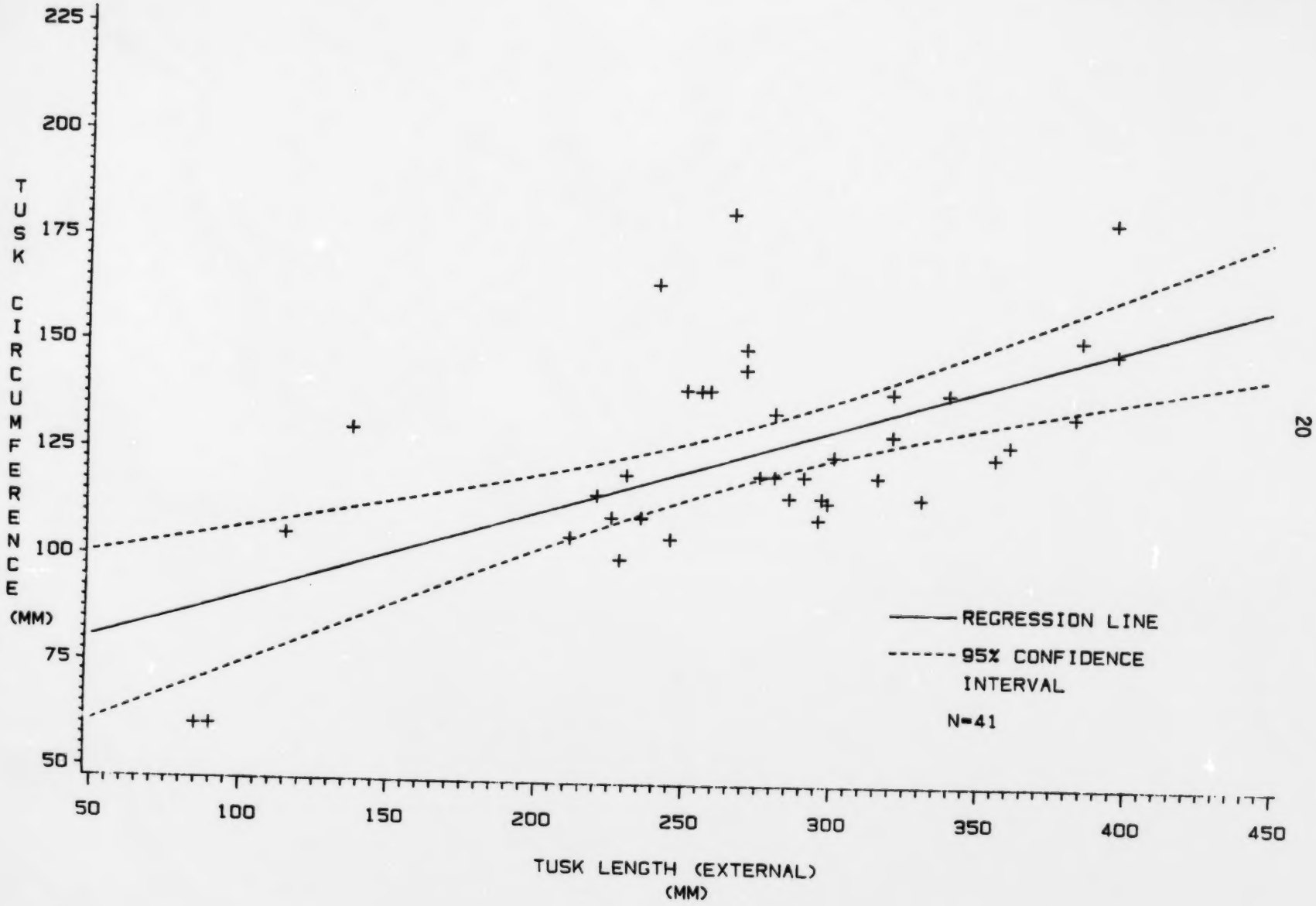


Fig. 8b. Tusk circumference vs tusk lengths of harvested female walrus 1982-1984.

Appendix 1. Sample sheet used during 1982.

PINNIPED SPECIMEN NO. _____

SPECIES _____ LENGTH _____ SEX _____
LOCALITY _____ GRID REFERENCE _____
DATE _____ RECORDER _____
PIGMENTATION: NORMAL _____ ABNORMAL _____
PHYSICAL CONDITION: THIN _____ NORMAL _____ FAT _____
TEETH: I _____ C _____ PM _____ M _____
TUSKS: COLOR _____ L-LENGTH _____ B.DIAM. _____ BROKEN _____
R-LENGTH _____ B.DIAM. _____ BROKEN _____
STOMACH CONTENTS: QUANTITY _____ SPECIES _____

FEMALE: OVARIES	LEFT	RIGHT	MALE: TESTES	LEFT	RIGHT
WEIGHT			WEIGHT:		
CORP. LUTEX			LENGTH:		
	UTERINE CORNUA		WIDTH:		
DIAMETER			DEPTH:		
			SPERM IN EPIDIDYMUS		

MAMMARY GLANDS: MILK QUANTITY - NONE _____ SMALL _____ MED _____ LGE _____
LENGTH _____ WIDTH _____ THICKNESS _____
FOETUS PRESENT: __ _____ SEX _____ TOTAL LENGTH _____

- MAKE OUT SEPARATE SHEET FOR FOETUS -

WEATHER: SUNNY _____ CLOUDY _____ RAIN/SNOW _____ WINDY _____ FOG _____
CALM _____ RIPPLES(1"-6") _____ WAVES (6"-2') _____ ROUGH(2'+) _____
ANIMAL: IN WATER _____ HAULED OUT _____ SOLITARY _____ NO. OF OTHERS _____
HUNTER(S): NUMBER _____ SUCCESSFUL HUNTERS NAME(S) _____
SETTLEMENT: _____
TIME: AT BEGINNING OF HUNT _____ AT END OF HUNT _____
NO. OF WALRUS: SEEN _____ SHOT AT _____ HIT _____ RECOVERED _____ LOST _____
CALIBRE OF RIFLE _____ NO. OF SHOTS/WALRUS _____
WALRUS HARPOONED BEFORE BEING SHOT? YES _____ NO _____
COMMENTS: _____

SAMPLES TAKEN

JAW, LOWER, ½ WITH TEETH _____ TESTES: R _____ L _____
UTERUS _____ OVARIES: R _____ L _____ FOETUS _____
EYES: R _____ L _____ SKELETAL MUSCLE _____ BONE _____
HEART MUSCLE _____ KIDNEY _____ LIVER _____
BLUBBER OR OTHER FATTY TISSUE _____ BLOOD _____
ECTOPARASITES _____
ENDOPARASITES _____
OTHER _____

Appendix 2. Sample sheet used during 1983 and 1984.

Fisheries and Oceans / Pêches et Océans

MARINE MAMMAL MANAGEMENT
501 UNIVERSITY CRESCENT
WINNIPEG, MANITOBA R3T 2N6

PINNIPED DATA SHEET

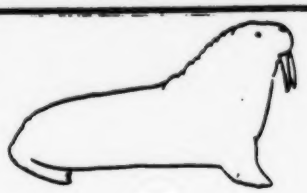
SAMPLE NO._____ PHOTO NO.'s_____ SPECIES_____

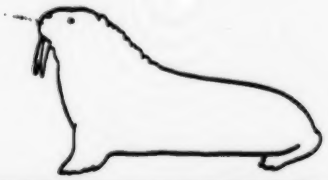
Sex _____ Maturity _____ Time/Date _____ Grid Location _____

Recorders _____ Hunter _____ Community _____

Weather: Wind _____ Sky _____ Water/Ice _____

METHOD OF CAPTURE*:





No. of hunters in party _____

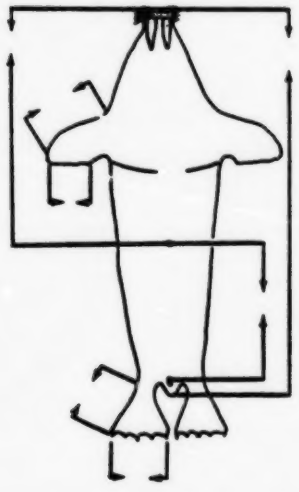
No. of previously unsuccessful attempts _____

No. of previously hit and lost _____

Animal: In Water _____ Hauled out _____

Solitary _____ No. of others _____

*Record the site of bullet entries (numbered), location of scars, wounds, and osteopathies on diagrams



C — Circumference
SL — Standard Length
OC — Outside Curve

RIGHT:
C _____
SL _____
OC _____

LEFT:
C _____
SL _____
OC _____

TUSK COLOR:
BROKEN? L R

LONGEST MISTACIAL VIBRISSAE _____cm

BLUBBER THICKNESS
Dorsal _____cm
Lateral _____cm
Ventral _____cm

HEART WEIGHT _____kg
GIRTH _____cm

BACULUM WEIGHT _____kg
LENGTH _____cm

TESTIS WEIGHT R _____kg L _____kg
LENGTH R _____cm L _____cm
WIDTH R _____cm L _____cm
HEIGHT R _____cm L _____cm

UTERINE HORNS:
LENGTH R _____cm L _____cm
WIDTH R _____cm L _____cm

SAMPLE CHECKLIST:

Eyes	____
Blubber	____
Muscle	____
Liver	____
Kidney	____
Heart	____
Lungs	____
Spleen	____
Stomach contents	____
Stomach	____
Lower jaw	____
Testis	____
Ovaries	____
Foetus	____
Blood	____
Parasites	____
Other:	____

STOMACH CONTENTS:
Quantity
Composition

DENTITION:

	I	C	PM
Right	____	____	____
Left	____	____	____

FOETUS: DATA BELOW ____ DATA SEPARATE. SEE SAMPLE NO. _____
Sex _____ Length _____cm
Weight _____kg Girth _____cm
Placental Weight _____kg

REMARKS:

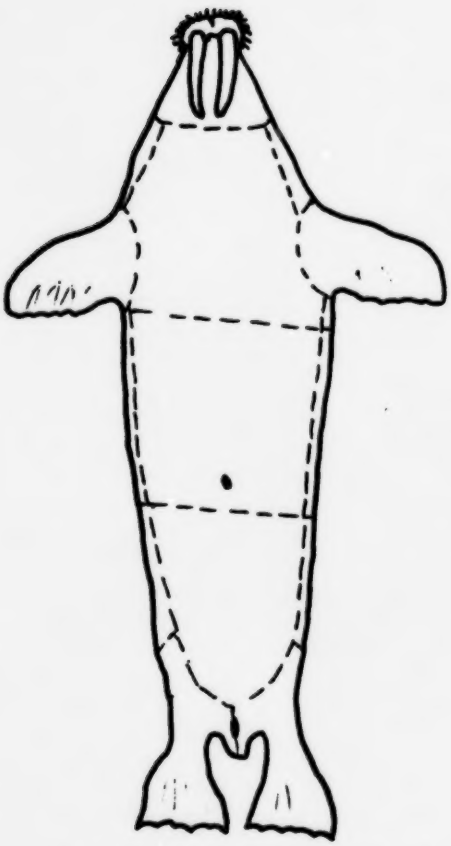
Canada

APPENDIX 3

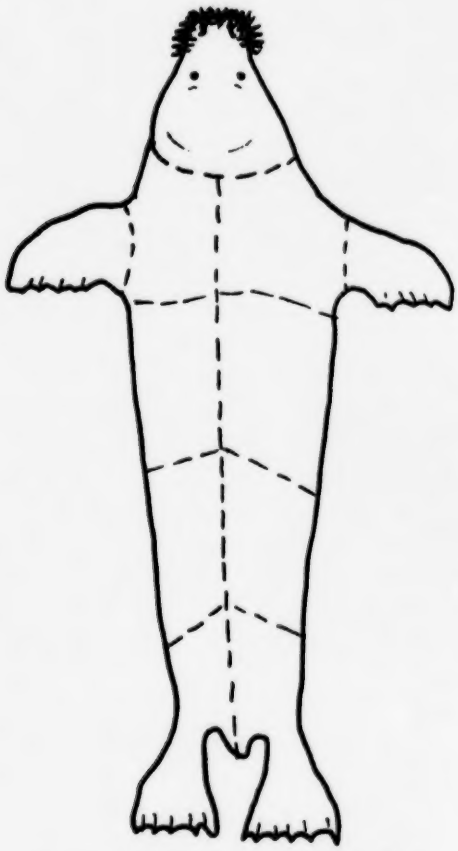
TYPICAL BUTCHERING METHOD DESCRIPTION AND MEAT UTILIZATION OF WALRUS BY IGLOOLIK HUNTERS

With the walrus lying on its back, the hunter makes two lateral incisions along the body just ventral to the foreflippers and extending to the anus. A transverse incision is made at the throat and the entire ventral slab is peeled off the rib cage and abdomen, resulting in a strip of hide, blubber, and muscle 2.5 m long by 0.8 m wide. The foreflippers and head are then cut off, following which the heart, lungs, diaphragm and digestive tract are removed. One man then pulls the ribs laterally as the other frees the dorsal skin and blubber from the dorsal surface of the ribs. The ribs, vertebrae and pelvis are then rolled out of the remaining carcass and set aside. The dorsal slab of skin and blubber is split lengthwise along the centre, and each side is cut into three nearly equal sized squares. The most posterior square still has the hindflippers attached, although the femur has been removed. The ventral slab is also split into three nearly equal sized squares, resulting in a total of nine squares for the entire carcass. Large knives with blades approximately 30 cm long are used to cut large holes around the perimeter of the hide on each slab. The ventral surface of the foreflippers is peeled off down to the manus but left attached by a strip of hide approximately 2 cm wide at the edge of the manus (Appendix 4). This is the base of rope that is cut from the hide as it is rolled from the foreflipper. The squares of hide, blubber and meat are then laced up with this rope into large sausage shaped bundles with the hide forming the outside. Pieces of liver, heart, and occasionally intestines are stuffed into any bundles of meat that may have been tied too loosely. The bundles are taken to gravel beach ridges and buried in two layers, with the seams towards the centre of the pile. The caches are reopened during winter and spring and used for both human and dog food.

Appendix 4. Diagram of butchering method used by Igloolik hunters.



Ventral aspect of butchering



Dorsal aspect of butchering

---cut lines

ventral view of foreflipper

Area where lacing rope is taken